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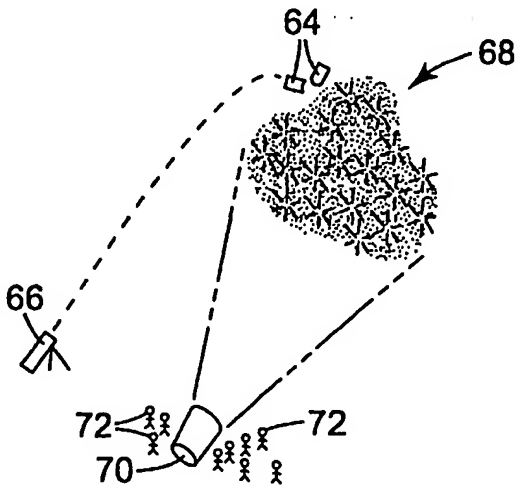
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: RETROREFLECTIVE CONFETTI



(57) Abstract: Retroreflective sheeting is divided into pieces, collected, and used as decorative confetti. The confetti can be used to create striking visual displays by dispersing the confetti in the air at a position viewable by one or more observers and illuminated by one or more light sources situated proximate the observer(s). A striking multi-colored display results when pieces of different colored sheeting is used.

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RETROREFLECTIVE CONFETTI

Background

The present invention relates generally to decorative visual displays. More particularly, the invention relates to decorative visual displays involving the use of confetti.

The reader is directed to the glossary at the end of the specification for guidance on the meaning of certain terms used herein.

For centuries, fireworks have provided spectacular visual displays for important celebrations such as national holidays. Fireworks, however, are generally limited to outdoor use, and the falling ignited particles can pose a fire danger.

Confetti comprising small bits of paper has also been used for celebrations such as parades. The confetti is thrown out of windows or projected into the air and allowed to fall gently to the ground. The confetti helps create a festive mood, but the attention of onlookers is not drawn to the confetti in the same way that it is drawn to fireworks.

PCT Publication Nos. WO 99/36477 (Whitney et al. I) and WO 99/36478 (Whitney et al. II) discloses glitter that, in loose form, can be used as confetti and thrown into the air to create a visual display or effect. The glitter comprises particles of a film comprising a plurality of alternating layers of at least a first and second polymeric material wherein at least one of the first or second polymeric materials is birefringent. Confetti using other types of materials and using specific particle shapes has also been proposed in the literature. However, the confetti of the prior art is generally composed of particles that are either diffusely reflective, such as ordinary white office paper, or specularly reflective, such as the glitter of Whitney et al. I or II.

As audiences become exposed to a wider variety of visual displays, entertainers desire to produce novel types of visual displays that can offer surprisingly different and striking visual effects.

Retroreflective materials have been used for many decades in roadway signs and vehicle license plates to increase the conspicuity of such items to vehicle drivers. Retroreflective materials have the property of reflecting incident light, such as light from a vehicle headlamp, back in the general direction from which the light originated,

regardless of the angle at which the incident light impinges on the surface of the material. Thus, roadway signs, license plates, and persons that use retroreflective material on their outer clothing can be highly visible to drivers of vehicles at night.

To achieve the desired retroreflectivity, existing retroreflective sheeting generally uses either: (i) a monolayer of tiny glass beads or microspheres that cooperate with a specular or diffuse reflector, or (ii) a surface provided with a multitude of specularly reflective facets arranged as prismatic cube corner elements. In the case of beaded retroreflective sheeting, the beads can be embedded between layers of polymers, or partially exposed to the atmosphere, or partially exposed to air that is trapped between a substrate in which the beads are partially embedded and a transparent cover film that is selectively bonded to the substrate. In the case of cube corner sheeting, the facets of the cube corner elements can individually reflect by total internal reflection at a polymer-air interface, or by reflection at a metal film or the like.

Applying small pieces of retroreflective sheeting to fabrics or other substrates to make such substrates retroreflective has been proposed by others. *See, e.g.* U.S. Patent No. 4,103,060 (Bingham et al.) and PCT Publication WO 99/31534 (Smith). Using metallic ribbons as chaff scattered from airborne sites for counter-radar purposes, each ribbon having reversed rows of cube corners pressed therein, has also been proposed. *See* U.S. Patent No. 4,149,304 (Brynjegard). However, pieces of retroreflective material have not been used in the past to create decorative visual displays.

Brief Summary

Disclosed herein is confetti composed of pieces of retroreflective material. The retroreflective confetti produces a brilliant display when dispersed into the air in a region illuminated by a light source and viewable by an observer who is situated close enough to the light source to view retroreflected light. A method of doing business includes collecting and packaging pieces of retroreflective material suitable for use as confetti, and providing the packaged pieces to a customer for use as confetti.

Brief Description of the Drawings

The invention will be described with the aid of the accompanying drawings, in which:

FIG. 1 is a perspective view of a container of retroreflective confetti;

FIG. 2 is a view of an entertainer dispersing the confetti of FIG. 1 into the air to create a decorative visual display;

FIG. 3a is a simplified two-dimensional representation of an observer, a light source, and a piece of confetti, the figure also illustrating the entrance angle β and the observation angle α;

FIGS. 3b,c,d are views similar to FIG. 3a wherein the piece of confetti is a diffuse reflector such as paper (FIG. 3b), a specular reflector such as a mirror film (FIG. 3c), and a retroreflector (FIG. 3d);

FIG. 4 is an idealized graph showing relative visual impact of an illuminated piece of confetti as a function of entrance angle β;

FIG. 5 is an overhead view of an arrangement for providing a brilliant visual display for a group of observers;

FIG. 6 is a perspective view of an alternative arrangement for providing a brilliant visual display for a group of observers; and

FIGS. 7a,b,c are sectional views of cube corner retroreflective material suitable for use as confetti.

In the drawings, the same reference symbol is used for convenience to indicate elements that are the same or that perform the same or a similar function. The drawings are not intended to be to scale or otherwise dimensionally accurate unless otherwise noted.

Detailed Description of the Illustrative Embodiments

FIG. 1 shows a box 10 filled with individual pieces of retroreflective material 12. The retroreflective pieces can be made most conveniently by providing larger pieces or even a long web of retroreflective material, and cutting at least a portion of the material to form the individual pieces. In one approach, a manufacturing or slitting line for a web of retroreflective material is provided. Material is removed along one or both edges of the web, and the removed material is further cut into pieces of a desired size, collected, and placed into box 10. The remainder of the retroreflective web material may undergo further processing, but is eventually used in conventional applications such as roadway signs, vehicle license plates, clothing, or the like. In another approach, pieces of retroreflective material that are a by-product of manufacturing, such as the

punched particles of PCT Publication WO 99/31534 or material trimmed from the edge of a web in the ordinary course of manufacture, can be used by themselves or as further reduced in size by cutting. Using such retroreflective by-product materials is advantageous from an environmental standpoint in reducing waste.

Regardless of the origin of the individual pieces of retroreflective material 12, they are collected and boxed or otherwise packaged so that they can be sold and shipped to a user. The user can be an end user such as an entertainer, a theatrical designer, a special effects designer, or the like. The user can alternatively be an entity in the chain of commerce between the manufacturer and the end user, such as a distributor or a business that further prepares the retroreflective confetti before distribution and sale to end users. Such further preparation may include, for example, packing the confetti into canisters that can be thrown or launched into the air, or mixing the confetti with water in a sealed transparent globe that can simulate a winter scene by shaking. In FIG. 2, an entertainer 14 throws a handful of the retroreflective material (in loose form) into the air to disperse the retroreflective pieces in a region 16 that can be viewed by an audience. With proper lighting conditions (discussed below), a large proportion of the randomly oriented pieces of confetti appear as intense points or spots of light to the audience. The intense points of light are represented by rays 18 emanating from the individual pieces in FIG. 2. For heightened visual impact it is desirable to include pieces of retroreflective material obtained from sheetings of different colors to produce a vivid multi-colored display. Each piece of retroreflective material then retroreflects light preferentially at a specific color such as white, red, yellow, green, blue, or any other desired color.

When packaging the retroreflective confetti for sale to a user, the simple box 10 of FIG. 1 can be used, as well as bags, canisters, and sealed, dissolvable, and/or frangible containers. Each bag, box, canister, or container can contain pieces of a single color, or instead a plurality of different colored-pieces can be packaged. The packaging can also serve as a dispenser for the confetti.

FIGS. 3a-d illustrate schematically the lighting conditions suitable for viewing the confetti in retroreflected light. FIGS. 3a-d also illustrate the fundamental differences

in reflectivity that make retroreflective confetti substantially more striking in visual appearance than either diffusely reflective confetti or specularly reflective confetti.

In FIG. 3a, a randomly oriented piece of confetti 20 is disposed to be illuminated by a light source 22 and viewed by an observer 24. The piece 20 has a front surface defining an axis 26 that is perpendicular to the surface. Axis 26 is also referred to as the surface normal of piece 20. An illumination axis 28 extends from the light source 22 to the piece 20. An observation axis 30 extends from observer 24 to piece 20. Angle β, as shown, is referred to as the entrance angle, and angle α is referred to as the observation angle.

In order to view light that may be reflected from a retroreflector, the observer 24 is close enough to the light source 22, or the piece 20 of confetti is far enough away from the observer 24 or light source 22, so that the observation angle α is very small, typically less than 2 degrees, more preferably less than 1 degree, and even more preferably on the order of about 0.2 degrees or less. A theoretically perfect retroreflector would only reflect light back along the path from which it was incident, such that only an observer 24 located on illumination axis 28 could view the retroreflected light. Practical retroreflective sheeting however directs light in a narrow cone centered on the illumination axis 28, such that an observer disposed proximate the light source 22 is able to view the retroreflected light. In this context, an observer "disposed proximate the light source" or a light source "disposed proximate the observer" means that the observation angle α is very small as described above, regardless of the physical distance between the light source and the observer.

FIG. 3b shows the same arrangement as that of FIG. 3a, except that the generic piece of confetti 20 is relabeled as piece 32, the front surface of which is diffusely reflective as with ordinary paper confetti. Light 34 that is incident upon piece 32 along illumination axis 28 strikes the confetti and is diffusely reflected in all directions, depicted as reflected light 36. The reflected light 36 enables the observer to perceive the confetti, but the diffuse reflection does not attract significant attention.

FIG. 3c also shows the same arrangement as that of FIG. 3a, except that the generic piece of confetti is relabeled as piece 38. Piece 38 is specularly reflective for light incident on its front surface, as with mirror film confetti. Light 34 that is incident

upon piece 38 along illumination axis 28 strikes the confetti and is specularly reflected in a direction that makes an angle of reflection θ with respect to surface normal 26 equal to the entrance angle β. The specularly reflected light 40 is directed away from the observer 24 in the situation shown, and thus the specularly reflective piece 38 will not be visible to observer 24 in the absence of other light sources. The piece 38 will be visible to observer 24 as a bright spot of light only when the piece 38 is oriented precisely to the point where surface normal 26 bisects the observation angle α. For a piece of confetti tumbling substantially randomly through the air (or other medium), this condition is met extremely rarely. Thus, only a tiny fraction of specularly reflective pieces 38 in a cloud of dispersed confetti appear bright to an observer at any given time. Moreover, the flashes of light reflected from such pieces are extremely brief.

FIG. 3d likewise shows the arrangement of FIG. 3a, except that the generic piece of confetti is relabeled as 42. Piece 42 is retroreflective for light impinging on its front surface. Light 34 that is incident upon piece 42 along illumination axis 28 strikes the confetti and is retroreflected in an intense beam or cone of light 44 that overlaps with the observation axis 30. The observer sees a bright spot of light. Because of the nature of retroreflection, the retroreflected light 44 remains centered on axis 28 for a wide range of entrance angles β. A piece of such confetti tumbling randomly through the air therefore appears bright to the observer for much of its travel time. In a cloud of randomly dispersed confetti, a large proportion of the individual pieces 42 appear as bright spots of light, in stark contrast to confetti of the prior art. The flashes of light, although brief because of the fluttering or tumbling action, have a much longer duration than mirror film confetti of like construction under like conditions. The result is a visual display with a distinctively different appearance than could be produced in the past.

FIG. 4 is an idealized graph (not to scale) of relative visual impact of the pieces of confetti shown in FIGS. 3b-d, as a function of the entrance angle β and for a fixed observation angle $\alpha = 0.2$ degrees. Curve 50 represents the relative visual impact of the diffusely reflective confetti piece 32 (FIG. 3b). Curve 50 is considerably lower than the maxima of the other curves but changes only gradually with entrance angle β. Curve 52 represents the relative visual impact of the specularly reflective confetti piece

38. Reaching a very high visual impact when β bisects α (in this case, when $\beta = 0.1$ degrees), curve 52 rapidly falls to near zero visual impact with a fraction of a degree change in β. Curve 54 represents the relative visual impact of the retroreflective confetti piece 42. Like curve 52, curve 54 has a very high peak visual impact. However, like curve 50 (and unlike curve 52), curve 54 decreases very gradually with increasing β. As an illustration, the coefficient of retroreflection R_A for most types of retroreflective sheeting available today changes from a maximum value at $\beta \approx 0$ degrees to half of its maximum value at $\beta \approx 30$ to 60 degrees. Thus, FIG. 4 illustrates in graphical fashion the tremendous advantage of retroreflective confetti over simple paper confetti or mirror film confetti.

Turning now to FIG. 5, an arrangement is shown for providing a brilliant visual display for a plurality of observers 56. Observers 56 are shown seated in an observation area 58 so that they can view region 60, where retroreflective confetti is dispersed. In order to enable the observers to view the confetti in retroreflected light, an array of light sources 62 is provided proximate observation area 58 such that the observation angle α remains small as discussed in connection with FIG. 3a. When that condition is met, the observers 56 perceive a dazzling visual display, an example of which is crudely depicted in FIG. 2.

Colors can be displayed particularly well with retroreflective confetti because of the high visual impact (unlike paper confetti), the relatively long duration flashes and high percentage of visually active pieces (unlike mirror film confetti), and ease of color selection (unlike fireworks). For best contrast, non-retroreflective objects in or near region 60 are dimly illuminated from the standpoint of observers 56.

FIG. 6 illustrates another arrangement for providing such a display. The retroreflective confetti is packed into a canister 64 which is launched high into the air by a cannon 66 or by other known means. *See, e.g.*, U.S. Patent Nos. 5,529,527 (Watkins) and 5,803,791 (Chiles); German Patent DE 29510276. While in the air, the canister releases the confetti in a region 68 that is illuminated by a spotlight or similar light source 70. Observers 72 are situated close enough to source 70 to observe the brilliant visual display produced by the retroreflective confetti.

FIGS. 7a-c illustrate three known types of retroreflective prismatic cube corner sheeting that can be used to make the retroreflective confetti of the invention. As noted earlier, beaded retroreflective sheeting can also be used for this purpose. Prismatic cube corner sheetings however generally have somewhat higher coefficients of retroreflection than beaded sheetings, and thus may be preferred in some applications.

In FIG. 7a, a retroreflective sheeting 74 is shown retroreflecting an incident beam of light 76. The retroreflection is achieved by a multitude of individual reflecting facets 78 arranged as cube corner elements 80. Each cube corner element comprises three approximately mutually perpendicular facets 78. The facets 78 can reflect light by total internal reflection or by a specularly reflective coating (not shown) such as aluminum. If desired, the cube corner elements can be tilted or canted in either a positive or negative sense such that their individual symmetry axes are nonparallel to the surface normal of the front 82 of the sheeting. The sheeting is preferably composed of polymeric materials for ease of manufacture. In the construction shown, the cube corner elements 80 are composed of a polymeric material having a relatively high elastic modulus, and are bonded to a body layer 84 composed of a polymeric material having a relatively low elastic modulus. This sheeting is described in more detail in U.S. Patent No. 5,450,235 (Smith et al.). The sheeting can be made to preferentially retroreflect certain colors by incorporating known dyes into cube corner elements 80, body layer 84, or an additional film to be laminated to front surface 82.

In FIG. 7b, another polymeric cube corner sheeting 86 is shown. Sheeting 86 includes a top film 88 and a cube corner layer 90, the layer 90 including cube corner elements as described above. The facets of the cube corner elements reflect by virtue of total internal reflection, and to preserve that reflection a seal film 92 is provided to maintain an air space 94 at the facets. Seal film 92 seals to portions 90a of layer 90 to provide closed cells of trapped air. Additionally, a pressure sensitive adhesive layer 96 is provided on the seal film and a readily removable release liner 98 is also included so that the sheeting can easily be applied to a substrate by removing the liner and pressing the adhesive against the substrate. When pieces of the sheeting are used as confetti, and provided the pieces are sized for easy manipulation by the human hand, observers may wish to retrieve fallen pieces so that they can apply the pieces to books, shoes, clothing,

or other desired substrates. Such retrieval can be further encouraged by die-cutting or otherwise shaping the pieces to have an outline in the shape of a cartoon character, letter, or other easily recognizable form.

Adhesive layers can of course be used on other cube corner sheeting constructions that do not include a seal film, and can also be used on beaded retroreflective sheeting. When using pieces of such sheeting as confetti, adhesive that is exposed along the periphery of each piece may cause some pieces to stick together so that they tumble in an undesirable manner. To avoid this potential problem a fine dust can be applied to the pieces before they are collected and packaged. Simply scattering the pieces onto an office or factory floor and sweeping up the pieces may suffice.

Adhesives or other bonding mechanisms can also be used to bond one retroreflective sheeting to another, and the resultant combination sheeting can then be cut up into pieces for confetti. The individual sheetings are preferably bonded to each other so that the combination sheeting is retroreflective from both sides. Pieces of such combination sheeting can double the brightness of a display made using an equal number of confetti pieces that are retroreflective on only one side. Further, the combination sheeting can have sheeting of a first color on one side and sheeting of a second color on the other side for enhanced visual effect.

Additionally, a thin foil of iron, steel, or other known materials that are attracted to magnets can be adhered to the back side of confetti pieces, or sandwiched between individual sheetings in a piece of combination sheeting, to aid in retrieval. The confetti can then be quickly and easily collected with a magnet for reuse in additional visual displays.

FIG. 7c shows a side sectional view of a known cube corner sheeting 100 that exhibits a glittering appearance in daytime lighting conditions. The cube corner elements 102 on the back side of the sheeting are randomly tilted to produce the glittering appearance. Such sheeting is sold by Minnesota Mining and Manufacturing Company under the product designation 3M™ Scotchlite™ Reflective Material High Gloss Sparkle Film, and is described in U.S. Patent No. 5,770,124 (Marecki et al.). Confetti made from pieces of this type of sheeting not only exhibits the distinctive retroreflective properties described above, but also can produce a pleasing glittering

effect in non-retroreflected light. In producing a visual display, additional light sources can be provided to illuminate the dispersed confetti from the side, from behind, and/or at oblique angles to accentuate the glittering appearance.

The confetti of the present invention can comprise irregularly shaped pieces such as are obtained by cutting up a strip of sheeting with a chipper-shredder, or regularly-shaped pieces such as are obtained by die-cutting. Regularly-shaped pieces can have the outline of well-known symbols, characters, insignia, or copyrighted or trademarked subject matter. The pieces can also be molded, bent, twisted, or curled to form non-planar shapes for enhanced fluttering, tumbling, or visual effects. The confetti need not consist exclusively of pieces of retroreflective material, but can also include pieces of more conventional confetti. With respect to size, the maximum dimension ("width") of the individual pieces of confetti can vary widely. For most applications, widths on the order of about 0.1 to 1 inch will be adequate for display purposes and convenient for handling. Other applications may well benefit from widths substantially smaller or larger than this range.

In general, the reflectivity of a piece of retroreflective material depends not only on the entrance angle and observation angle, but also on the angle of rotation about an axis perpendicular to the piece. This angle of rotation is commonly referred to as the orientation angle. Effects of orientation angle are usually minimal for beaded retroreflective sheeting because of the inherent rotational symmetry of the beads. Such effects are more significant for cube corner prismatic sheeting, and may be exploited in the design of particular visual effects.

As an alternative to retroreflective confetti, confetti can be made from known polymeric sheeting that is only partially retroreflective. One such sheeting, described in U.S. Patent No. 5,056,892 (Cobb, Jr.) has a structured surface of parallel linear prisms that retroreflect light only if the illumination axis of the light source is perpendicular to the prism axes. Because pieces of such sheeting are not fully retroreflective, confetti composed exclusively of such material would not be expected to have a visual impact as great as a confetti of retroreflective particles.

Light sources that can be used in visual displays of the invention include conventional floodlamps, arc-lamps, incandescent bulbs, and the like. The sources can

be continuous or strobed/pulsed. Laser sources can also be used, as long as adequate measures are taken to avoid eye damage to observers. The sources can be mounted in a fixed position or instead moveable with the head of an observer, as on a hat or held by hand close to the observer's eyes.

Glossary of selected terms

"Confetti" means pieces of material that in use are dispersed or scattered into the air or other fluid medium for visual effect.

"Entrance angle" means the angle between the illumination axis and the surface normal.

"Illumination axis" means an axis that extends from a light source to a surface of interest.

"Light" means electromagnetic radiation perceptible to the human eye, generally in the range from about 400 to 700 nm in wavelength.

"Observation angle" means the angle between the illumination axis and the observation axis.

"Observation axis" means an axis that extends from a surface of interest to a detector such as the eye of an observer.

"Reflectivity" is a measure of the apparent brightness of an article when viewed under standard retroreflective conditions (i.e., -4° entrance angle, and 0.2° observation angle), which brightness is normalized for the area of the article and the illumination from the light source used. The reflectivity is also referred to as the coefficient of retroreflection (R_A), and is expressed in units of candelas per lux per square meter ($cd/(lux \cdot m^2)$) Reference is made to ASTM Standard Method E808-98, "Standard Practice For Describing Retroreflection".

A "retroreflective" article is one that reflects a sufficient amount of light incident upon it at an oblique angle back in the general direction from which the light originated, so that the article has a reflectivity of at least about 10 $cd/(lux \cdot m^2)$. Preferred retroreflective articles have a reflectivity of about 100 $cd/(lux \cdot m^2)$ or more, and most preferably about 500 $cd/(lux \cdot m^2)$ or more.

"Surface normal" means an axis passing through a surface of interest and oriented perpendicular to such surface.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes can be made in form and detail without departing from the spirit and scope of the invention.

CLAIMS:

1. Retroreflective confetti.

2. The confetti of claim 1, wherein the confetti comprises pieces of polymeric retroreflective sheeting.

3. The confetti of claim 2, wherein the pieces of sheeting each have a maximum lateral dimension from about 0.1 to about 1 inch.

4. The confetti of claim 2, wherein at least some of the pieces of sheeting have prismatic cube corners formed therein.

5. The confetti of claim 2, wherein at least some of the pieces of sheeting have a layer of glass beads therein.

6. The confetti of claim 2, wherein at least some of the pieces of sheeting are retroreflective for light incident on a front side thereof and a non-retroreflective for light incident on a back side thereof.

7. The confetti of claim 6, wherein at least some of the pieces of sheeting comprise an adhesive layer proximate the back side.

8. The confetti of claim 2, wherein at least some of the pieces of sheeting are retroreflective for light incident on both a front side and a back side thereof.

9. The confetti of claim 8, wherein at least some of the pieces of sheeting retroreflect light preferentially at one color for light incident on the front side and retroreflect light preferentially at a different color for light incident on the back side.

10. The confetti of claim 2, wherein at least a first plurality of the pieces of sheeting retroreflect light preferentially at a first color.

11. The confetti of claim 2, wherein the pieces of sheeting retroreflect light preferentially at a variety of different colors.

12. The confetti of claim 11, wherein the variety of different colors are selected from white, red, yellow, green, and blue.

13. The confetti of claim 2, wherein at least some of the individual pieces have a daytime glittering appearance.

14. The confetti of claim 2, wherein at least some of the individual pieces are shaped to be non-planar.

15. The confetti of claim 2, wherein at least some of the individual pieces comprise a material attracted to magnets.

16. A method of doing business, comprising:
providing a sheet of retroreflective material;
cutting at least a portion of the retroreflective material into pieces suitable for use as confetti;
collecting and packaging the pieces of retroreflective material; and
providing the packaged pieces of retroreflective material to a customer for use as confetti.

17. The method of claim 16, wherein the customer is an end-user of the confetti.

18. The method of claim 16, wherein the customer further prepares the pieces of retroreflective material for an end-user.

19. The method of claim 16, wherein the cutting step comprises cutting only a portion of the retroreflective material into pieces suitable for use as confetti.

20. The method of claim 16, wherein the cutting comprises feeding the retroreflective material into a chipper shredder.

21. The method of claim 16, wherein the collecting and packaging comprises collecting pieces of different colored retroreflective materials.

22. A method of providing a striking visual display for at least one observer, comprising:

providing at least one light source proximate the observer;

providing a quantity of retroreflective confetti; and

dispersing the confetti in a region viewable by the observer and illuminated by the light source.

23. The method of claim 22, wherein the providing at least one light source includes providing a plurality of stationary light sources proximate an observation zone.

24. The method of claim 22, wherein the providing at least one light source comprises providing at least one light source for each observer.

25. The method of claim 24, wherein the dispersing comprises throwing the confetti into the region by hand.

26. The method of claim 22, wherein the dispersing comprises launching a canister containing the confetti.

27. The method of claim 22, wherein the dispersing comprises dropping the confetti from a position that is elevated relative to the at least one observer.

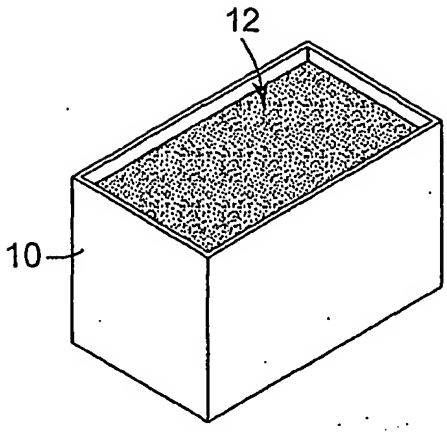

Fig. 1

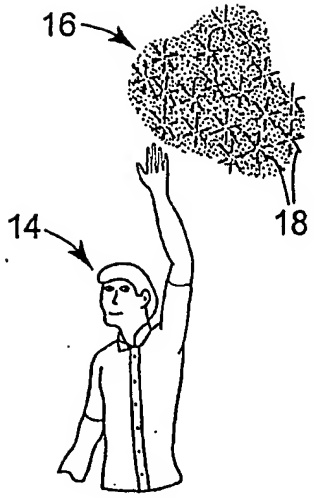

Fig. 2

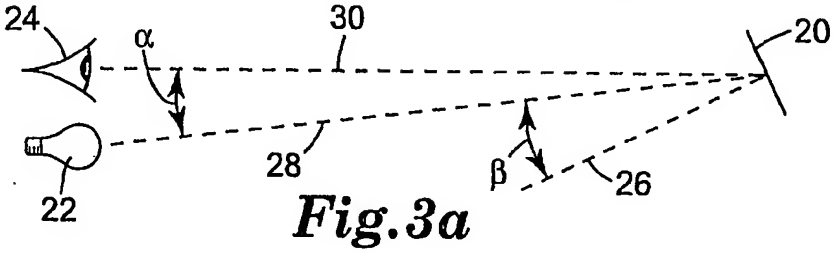

Fig.3a

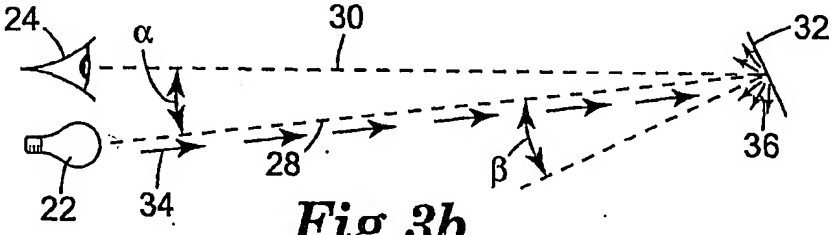

Fig.3b

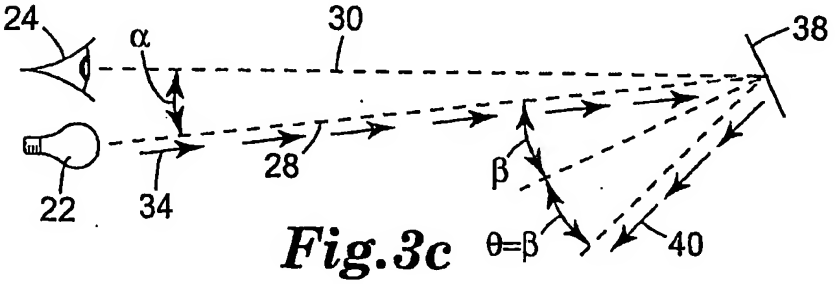

Fig.3c

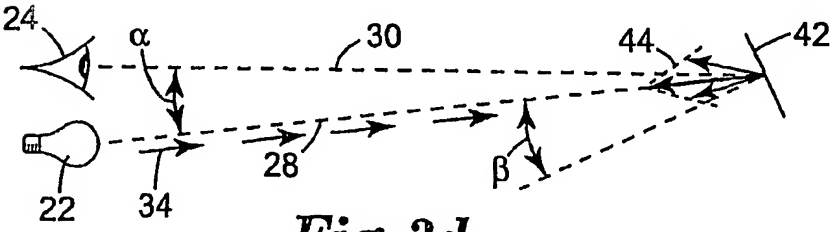

Fig.3d

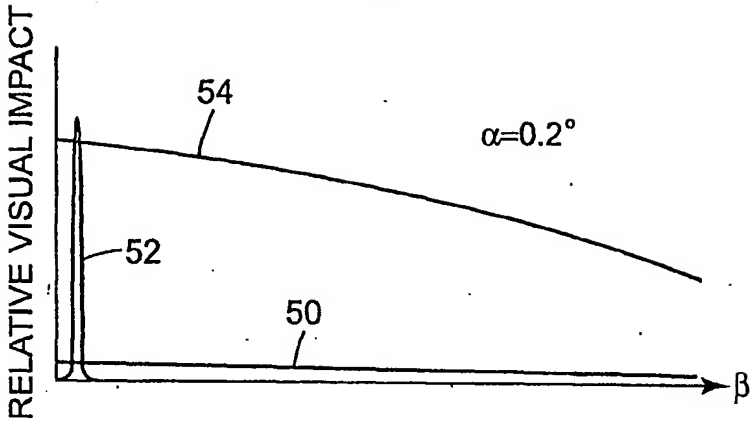

Fig. 4

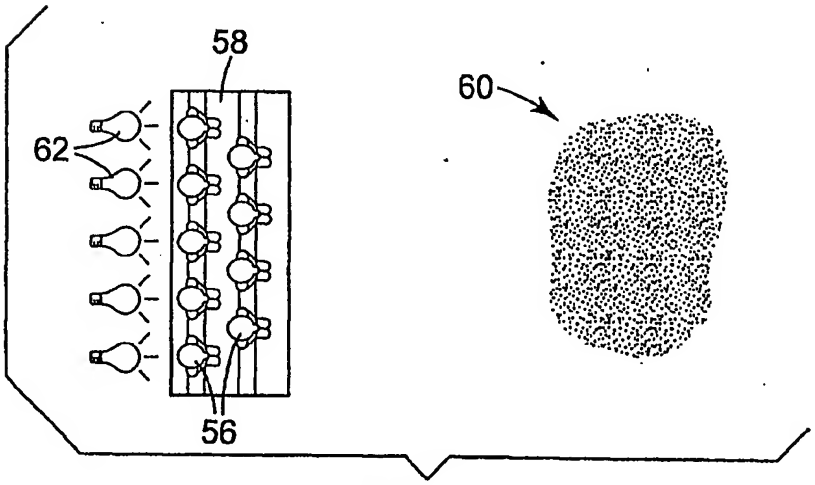

Fig. 5

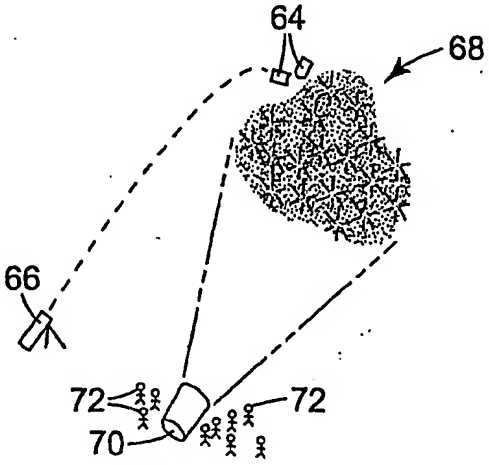

Fig. 6

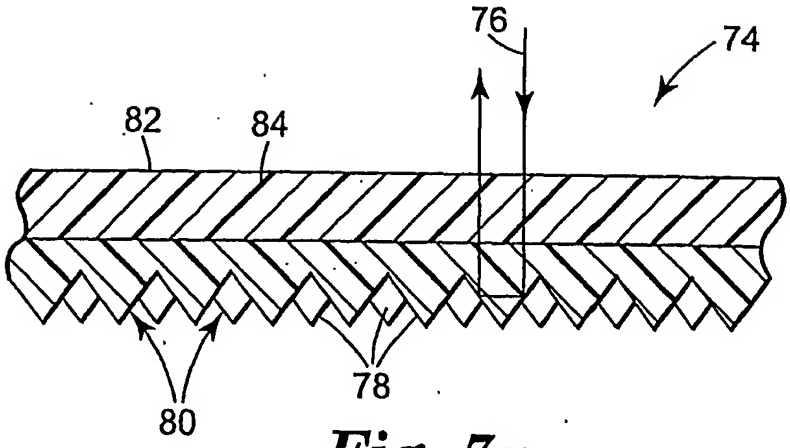

Fig. 7a

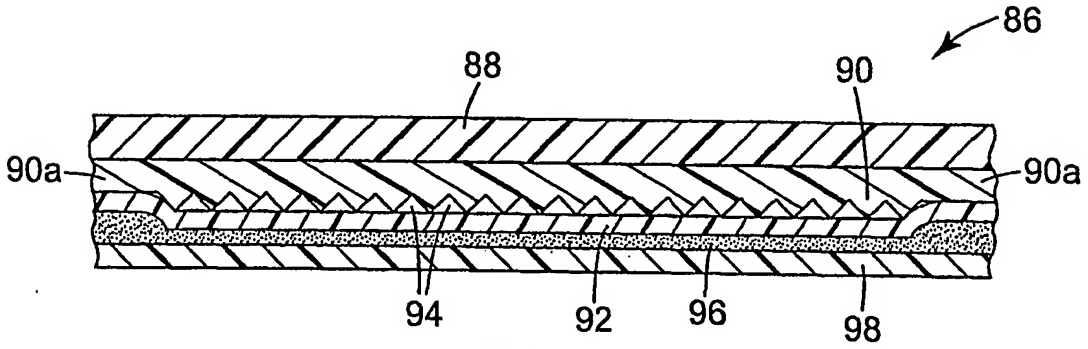

Fig. 7b

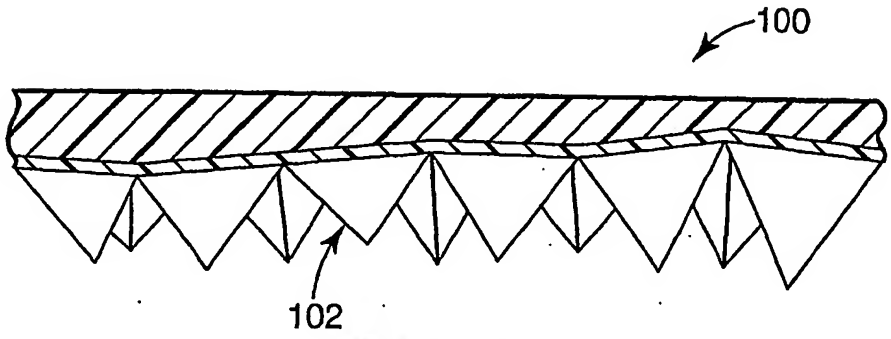

Fig. 7c

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 00/14525

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A63H37/00 G02B5/124

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A63H G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC, COMPENDEX, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 31534 A (REFLEXITE CORP) 24 June 1999 (1999-06-24) cited in the application page 8, line 8-10 figure 3	1-6,10
A	WO 99 36478 A (MINNESOTA MINING & MFG ;OUDERKIRK ANDREW J (US); SCANLAN THOMAS J) 22 July 1999 (1999-07-22) cited in the application page 7, line 22,23	1,2,11, 16,22
A	US 5 582 532 A (TUCKER SHERIDAN G) 10 December 1996 (1996-12-10) column 2, line 64-67	1,11,13

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 September 2000	18/09/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Chabus, H

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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P,X	EP 0 976 529 A (3M INNOVATIVE PROPERTIES COMPA) 2 February 2000 (2000-02-02) page 8, line 5-10 page 13, line 24-27 page 13, line 36-38	1,2

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INTERNATIONAL SEARCH REPORT

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Inte onal Application No
PCT/US 00/14525

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